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Each of the applications refer to a lighting device which strives to collect all of the light from a LED element and direct all of the light into a required concentrated beam. Each of them appear to achieve this result equally. In fact, there are substantial differences when they are compared using the crucial issue of light management requiring the loss profiles due to transmissivity, refraction, reflection and optical surface precision to be considered. Any one of the copending designs can become the superior design depending upon factors which apply to a particular use. These use factors include: temperature range, ultraviolet degradation, toughness required, shrinkage of resin, permitted shape and required light beam pattern, etc. etc. Even with all the copending applications in hand, a designer would have to calculate all of the loss profiles for each of the designs for a particular use profile before he could find the superior design for a particular use. Knowledge only of the claims of one of the copending applications would not, when added to prior art, provide motivation that the design be modified to the claims of a second copending application. Additionally, none of the referenced prior art suggested that the design of an LED light source could be optimized by including the loss profiles, from reflection, refraction, transmission and optical surface. Thus, even if each of the copending applications claims are known, there is no motivation to choose one design over the other. Applicant has disclosed and claimed multiple designs which are substantially different in the most critical area of light management. Applicant has further disclosed in the specifications the motivation for each design as they are uncovered by the design objectives also uniquely found in applicant's specification.

2. Applicant's residence is correct in the oath.

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3. Original claims 1-21 have been cancelled and replaced with

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new but similar claims 22-36 to define them over the copending applications.

SECTION 2

CHANGES IN THE CLAIMS IDENTIFIED

Original Claims 1-21 Cancelled and replaced with corresponding new claims 22-36 found in section 4.

SECTION 3

DISCUSSION OF PRIOR ART AS IT

RELATES TO APPLICANT'S CONCEPT AND CLAIMS

Sakai has offered a design that appears to be perfect thus there is no prior art reason to modify it. Thus there is no prior art motivation to add Bitner to Sakai. In fact there are reasons why Bitner would not be added to Sakai. In that regard Bitner employs a refracting surface B and C to bend his light and make it parallel prior to his reflecting surface D and F. This concept would not function with the parabolic surface of Sakai which requires diverging light from a point at the Sakai LED light source. Bitner additionally offers the concept of using a reflector to direct the refracted and now parallel light towards a point. This concept is not a desirable addition over Sakai. In fact, generally the more the light is refracted the greater the loss of light that will be experienced. From an efficiency perspective more bending generally means more losses. It is normally to be avoided. Bitner's reflector sends the light towards a point and his refractor must then refract the light to make it parallel to his axis. This adds to the losses over Sakai.

Sakai like the current invention incorporates a LED light source. This light source has a unique spatial radiation pattern vastly different from that of an incandescent light source. In addition, the incandescent lamp cannot reasonably be encapsulated in a transparent medium whereas the LED light source usually

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requires a transparent medium to protect and support it. The transparent medium naturally acts as an optical surface and becomes an important part of the optics of the device. Therefore, the management of the light energy will be vastly different when using the LED light source. Thus prior art which used incandescent light sources may not be reasonably applied to Sakai or applicant unless the issues related to a LED source and a refractive housing or an encapsulation for a LED source have been disclosed by prior art.

Table III provided on the following page lists in column A elements not required in the current application but present in each prior art. Also Table III lists in column B elements in the current application which are not included in each of the prior art references.

| PRIOR ART REFERENCE | THE REFERENCED PRIOR ART INCLUDES THE FOLLOWING ELEMENTS WHICH ARE NOT INCLUDED IN THE CURRENT APPLICATION 08/647,461 | THE REFERENCED PRIOR ART DOES NOT INCLUDE THE FOLLOWING ELEMENTS WHICH ARE INCLUDED IN ALL INDEPENDENT CLAIMS OF THE CURRENT APPLICATION 08/647,461 |
|-------------------------|---|--|
| 1,880,892 Dodge | A classical lens with two surfaces, one surface glued to a lamp. Optical surfaces developed about axis | A complete lighting devise including a LED source, with its unique spatial radiation pattern, interacting with optics. Elliptical reflector with its axis intersecting reference axis directs light converging about axis and towards points. Refractor to refract light to become parallel to axis. |
| 1,997,689 Muller | A classical lens with two surfaces. A hollow cylindrical section receiving a light source. Optical surfaces developed about axis | A complete lighting devise including a LED source, with its unique spatial radiation pattern, interacting with optics. Elliptical reflector with its axis intersecting reference axis directs light converging about axis and towards points. Refractor to refract light to become parallel to axis. |
| 2,215,900 Bitner | A classical lens with two surfaces, a refractor before the reflector. Optical surfaces developed about axis. | A complete lighting devise including a LED source, with its unique spatial radiation pattern, interacting with optics. Elliptical reflector with its axis intersecting reference axis directs light converging about axis and towards points. Refractor to refract light to become parallel to axis. |
| 2,254,961 Harris | A classical lens with two surfaces. All optical surfaces developed about axis, refractive surface with focal point. | A complete lighting devise including a LED source, with its unique spatial radiation pattern, interacting with optics. Elliptical reflector with its axis intersecting reference axis directs light converging about axis and towards points. Refractor to refract light to become parallel to axis. |
| 2,254,962 Harris | A classical lens with two surfaces, both elliptical surfaces having the same focus. A refractive surface with focal point. A light well. All disclosure shows rotary surfaces developed about axis. | A complete lighting devise including a LED source, with its unique spatial radiation pattern, interacting with optics. Elliptical reflector with its axis intersecting reference axis directs light converging about axis and towards points. Refractor to refract light to become parallel to axis. |
| 2,356,654 Cullman | A classical lens with two surfaces. A linear light source. | A complete lighting devise including a LED source, with its unique spatial radiation pattern, interacting with optics. Elliptical reflector with its axis intersecting reference axis directs light converging about axis and towards points. Refractor to refract light to become parallel to axis. |
| 2,362,176 Swanson | A classical lens with two surfaces, a "full beam" lamp with optical elements that completely surround the light source Col. 1 lines 8-16. A chamber for a light source. | A complete lighting devise including a LED source, with its unique spatial radiation pattern, interacting with optics. Elliptical reflector with its axis intersecting reference axis directs light converging about axis and towards points. Refractor to refract light to become parallel to axis. |
| 2,469,080 Bosin | A classical lens with two surfaces. A well for a light source. All optical surfaces developed about an axis, axis is parallel to parabolic axis. | A complete lighting devise including a LED source, with its unique spatial radiation pattern, interacting with optics. Elliptical reflector with its axis intersecting reference axis directs light converging about axis and towards points. Refractor to refract light to become parallel to axis. |
| 4,698,730 Sakai | A planner upper surface called illumination output portion Col. 3 lines 20-45. This surface creates no refraction. All optical surfaces developed about an axis. This is also disclosed in the definition of illumination output portion. | A complete lighting devise including a LED source, with its unique spatial radiation pattern, interacting with optics. Elliptical reflector with its axis intersecting reference axis directs light converging about axis and towards points. Refractor to refract light to become parallel to axis. |
| 5,140,220 Hasegawa | A plurality of granular optical particles. | Reflector to create converging light. Reflector to create parallel light converging about plane. |
| 5,452,190 Priesemuth | A partially transparent member. | Reflector, refractor. Reflector to create parallel light converging about plane. |
| 2,224,178 Bitner | A classical lens with two surfaces, a refractor before the reflector. All optical surfaces developed about an axis. | A complete lighting devise including a LED source, with its unique spatial radiation pattern, interacting with optics. Elliptical reflector with its axis intersecting reference axis directs light converging about axis and towards points. Refractor to refract light to become parallel to axis. |

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Sakai discloses a device that does not comprise post reflection refraction. Applicant requires an elliptical reflector to reflect a diverging side light to form a light which converges about an axis. Applicant then requires a refractor which refracts the converging light to bring it towards parallelism with the axis. Sakai (4,698,730) does offer a reflector. However, his reflector 16b is parabolic and directs the diverging side light into a light parallel to his axis X (column 3, lines 39-45). Therefore Sakai does not employ a reflector to create a converging light. He does not reflect the side light to create a light converging about a reference plane. Further Sakai does not, after reflection, refract his light at surface 16a of FIG. 1. Surface 16a is planer (column 3, lines 26-30) and (column 5, lines 3-7). Also FIGs. 1 and 5 show no refraction at surface 16a. Therefore, Sakai does not disclose a refractor which brings converging light towards parallelism with an axis. At first look Sakai has the optimum design because by eliminating refraction at surface 16a he avoids the loss of light associated with refraction. Applicant has included a refractor and will therefore incur refractive losses that Sakai has avoided. However, applicant's design offers a more compact cross-section. Therefore, applicant will minimize both transmission losses and losses relating to the accuracy of his optics. Neither of these types of losses were issues disclosed by Sakai. Applicant's design accounts for all types of light loss.

Sakai does disclose a central lens 15a of FIG. 1 which does refract forward light. However, this is forward light and not the side light previously reflected as disclosed by applicant. The Sakai central lens is a second optical system used to concentrate the forward light in order to make the forward light parallel to the axis X. The central lens is especially desirable with a parabolic reflector (including a focal point at the light source) as they both make the light parallel to the axis. However, for designs which do not require the light to be made fully parallel to the axis the central lens can be unnecessary and

create undesirable refractive losses.

SECTION 3A
DISCUSSION OF COMBINED PRIOR ART AS IT
RELATES TO APPLICANT'S
CONCEPTS AND CLAIMS

The concept of combining prior art references can be discussed. Under section 8 regarding Sakai alone has been shown as not disclosing the current invention. Regarding the combination of Sakai (4,698,730) and Harris (2,254,961) -

1. Neither Sakai or Harris suggests the combination.
2. There would be no motivation to add the two concepts. Neither prior reference suggests the need for the combination.

In FIG. 5, Harris shows the problem of uncontrolled light passing through surface 27. He solves this problem by tilting his parabola as shown in FIG. 7 and described in page 2 lines 29-30. FIG. 7 of his patent includes a parabola with its axis tilted relative to the central axis of the lens and with its focal point at the light source. Harris claims to disclose a design which collects all of the light emitted into a hemisphere.

In FIG. 8, Sakai shows the same problem addressed by Harris of uncontrolled light except Sakai controls light from an LED element.

In FIG. 1 Sakai shows his solution to that problem including a parabola with its axis coincident with the central axis and its focal point at the LED element. Sakai requires a planer face 16a which permits the light reflected by his parabola 16b to exit the diode unrefracted. Sakai like Harris discloses a design which collects all of the emitted light.

Thus both Harris and Sakai have solved the same problem. Harris solved it for an incandescent source. Sakai solved it for an LED source. Both apparently (from their specifications) have perfect solutions. Thus there is no prior art motivation to add the two concepts.

3. It would be impossible to add the two designs without chang-

ing the disclosed invention of each. Sakai in FIG. 1 and column 3, lines 30-34 discloses a planer upper surface 16a which does not refract light. Harris in FIG. 7 and page 2, lines 30-50 discloses a conical surface 31 which requires the light to refract. Thus the two concepts cannot be combined.

Also Sakai in FIG. 1 discloses a parabola with its axis coincident with the central axis of the device. Harris on the other hand discloses in FIG. 7 a parabola with its axis tilted relative to the central axis of his lens. Thus the two concepts cannot be combined without changing the disclosed invention.

Harris within his specification and for every drawing discloses a lens including a spherical well FIG. 7 #29 or a cylindrical well FIG. 14 #67. When using the spherical well its diameter is disclosed as equal to the minor diameter of the ellipse page 2 right column lines 1-5. All of the numerous drawings provided by Harris disclosed the well. Additionally, all of the claims were for a "lens" and in the context of both the Harris specification and the classical definition of a lens a lens has two surfaces. No disclosure was made to reduce or eliminate that well or to shape it to cooperate with the shape of the light source body. Sakai discloses a light emitting diode with no light well. Thus the two concepts cannot be combined without changing the disclosed inventions. The use of the term "lens" by Sakai was different than Harris. Due to the Sakai specification a prior art definition was established whereby a single refractive surface was called a lens.

4. Absent the current application Sakai has created a light emitting diode that apparently achieves all the needs of such a device. Applicant has disclosed first an objective for improvement (i.e. reduce losses due to light transmission, reduce losses due to inaccurate optical contours by creating a reduced diameter or more compact lighting device and reduce losses by balancing the near and far point distances). Applicant then disclosed a method of providing the improvement (i.e. first reflecting and then refracting the light in order to reduce the size and balance

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the light path length). Applicant recognized that his design would probably increase the refractive loss profile over Sakai , however, when all of the loss profiles are considered, the current design is superior for many uses.

5. Harris discloses a lens without reference to the shape or size of the required light source. The Harris patent is for a unitary lens system. It is apparently for use with an incandescent light source. Usually incandescent lamps have thin glass housings which permit the light to pass through them experiencing only slight refraction or bending. Harris has not discussed the issue that many types of incandescent lamps have oblong housings or housing of variable thickness. He has not disclosed how that type of incandescent source would be employed. He did not disclose the effect that an oblong source or a source of any shape would have on his design. Thus Harris has not disclosed the need to modify his lens including his light well to accommodate a source having a different body contour (including an LED source) into his lens system. Harris requires a light source for his lens to function, however, he dose not disclose its required characteristics. Sakai discloses a light emitting diode light source. A logical combination of the two concepts would involve placing the Sakai source in the spherical well 29 of FIG. 7 disclosed by Harris. This would be the combination of both concepts which would maintain both concepts. This combination would not provide additional light collecting benefits when combined.